State-of-the-art Gamma-ray Spectroscopy to Enhance the ENSDF database

E.A. McCutchan, A.A. Sonzongi, S. Zhu

National Nuclear Data Center, Brookhaven National Laboratory

J.P. Greene, M. Gott

Argonne National Laboratory

P. Bender, P. Chowdhury

University of Massachusetts, Lowell

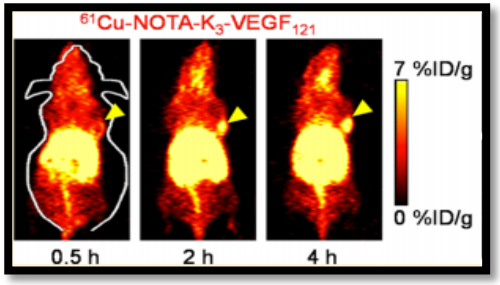
BROOKHAVEN NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

BROOKHAVEN SCIENCE ASSOCIATES

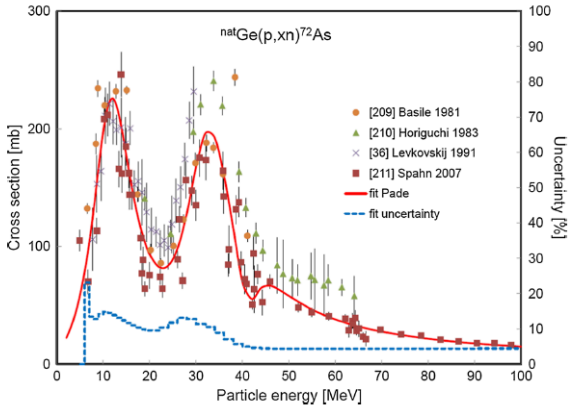
Decay Data on Medical Isotopes

Essential for use of the isotope
- Imaging
- Therapy
- Dose



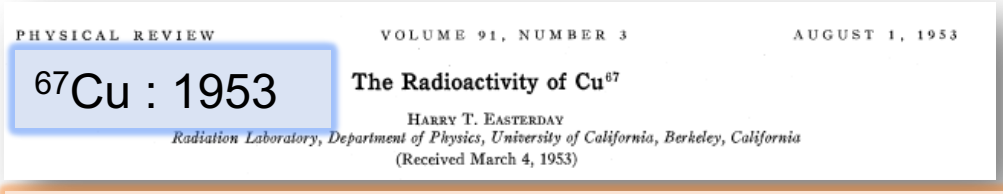
Yin Zhang et al., *Molecular Pharmaceutics*. Am Chem Society, 06 Oct. 2015.

Also often used to deduce cross section
- Through use of activation method



F.T. Tarkanyi et al., J. Rad. Nucl. Chem 319, 533 (2019).

A LOT of decay data measured decades ago without specific application in mind


PHYSICAL REVIEW VOLUME 91, NUMBER 3 AUGUST 1, 1953

The Radioactivity of Cu^{67}

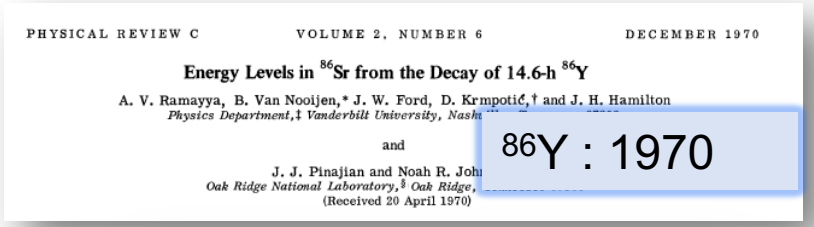
HARRY T. EASTERDAY

Radiation Laboratory, Department of Physics, University of California, Berkeley, California

(Received March 4, 1953)

^{67}Cu : 1953

Recently revisited by J. Chen, F. Kondev et al, (ANL)


PHYSICAL REVIEW C VOLUME 2, NUMBER 6 DECEMBER 1970

Energy Levels in ^{86}Sr from the Decay of 14.6-h ^{86}Y

A. V. Ramayya, B. Van Nooijen,* J. W. Ford, D. Krmpotić,† and J. H. Hamilton

Physics Department,‡ Vanderbilt University, Nash

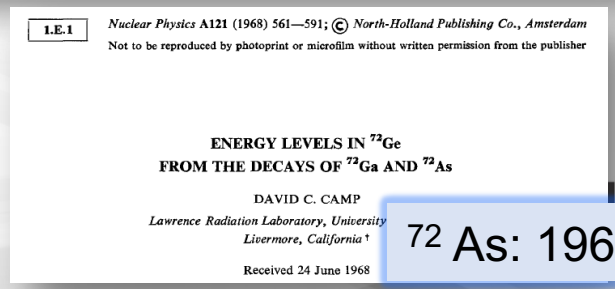
and

J. J. Pinajian and Noah R. Joh

Oak Ridge National Laboratory,§ Oak Ridge,

(Received 20 April 1970)

^{86}Y : 1970


1.E.1 *Nuclear Physics* A121 (1968) 561—591; © *North-Holland Publishing Co., Amsterdam*

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ENERGY LEVELS IN ^{72}Ge FROM THE DECAYS OF ^{72}Ga AND ^{72}As

DAVID C. CAMP

Lawrence Radiation Laboratory, University

Livermore, California†

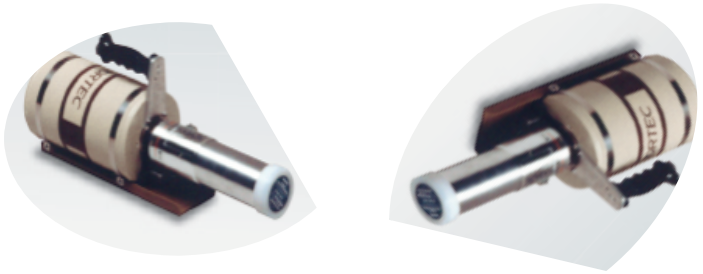
Received 24 June 1968

^{72} As: 1968

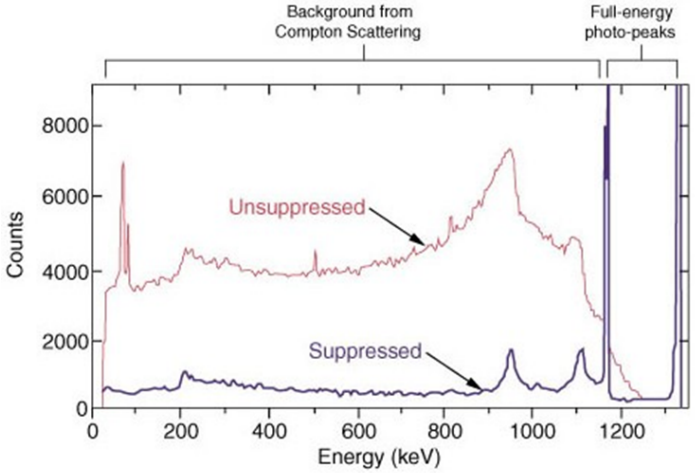
U.S. DEPARTMENT OF ENERGY

Advances in Gamma-ray Spectroscopy

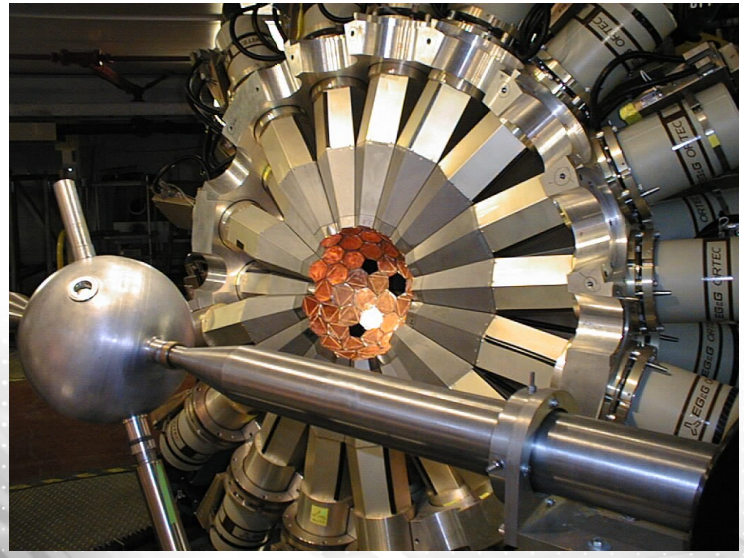
30 Years ago: 1-2 small detectors



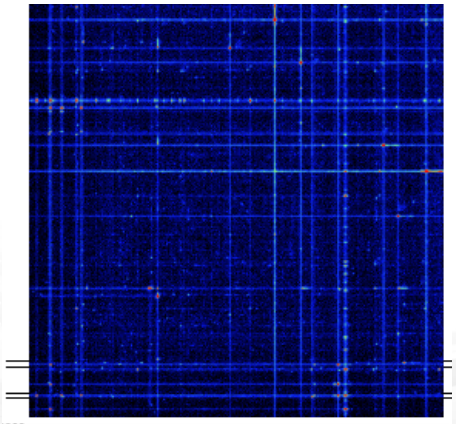
Compton-suppression



Present : 100 detectors
Gammasphere at ANL



Gamma-Gamma coincidences



As an example : ^{86}Y

IOP Publishing | Institute of Physics and Engineering in Medicine
Physics in Medicine & Biology
Phys. Med. Biol. 60 (2015) 3479–3497
doi:10.1088/0031-9155/60/9/3479

PET imaging with the non-pure positron emitters: ^{55}Co, ^{86}Y and ^{124}I

Eur J Nucl Med Mol Imaging (2016) 43:925–937

PHYSICAL REVIEW C VOLUME 2, NUMBER 6 DECEMBER 1970

Energy Levels in ^{86}Sr from the Decay of 14.6-h ^{86}Y

A. V. Ramayya, B. Van Nooijen,* J. W. Ford, D. Krmpotić,† and J. H. Hamilton
Physics Department,‡ Vanderbilt University, Nashville, Tennessee 37203

and

J. J. Pinajian and Noah R. Johnson
Oak Ridge National Laboratory,§ Oak Ridge, Tennessee 37803
(Received 20 April 1970)

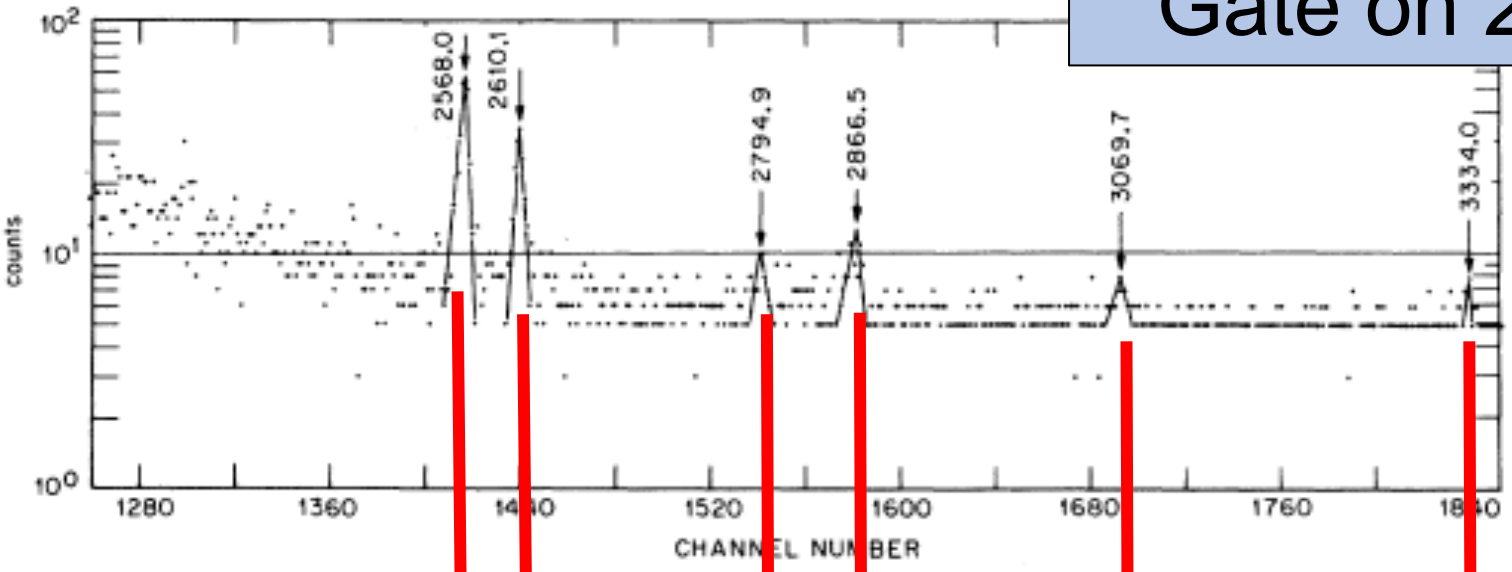
ELSEVIER
Applied Radiation and Isotopes
journal homepage: www.elsevier.com/locate/apradiso

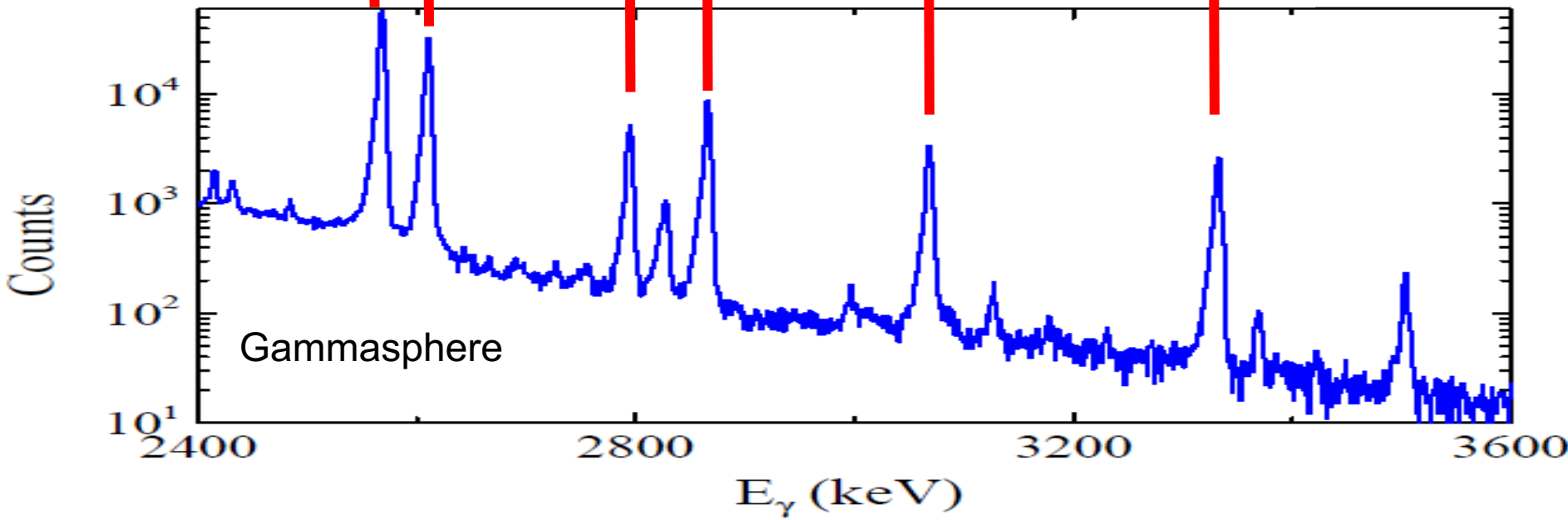
Tailoring medium energy proton beam to induce low energy nuclear reactions in $^{86}SrCl_2$ for production of PET radioisotope ^{86}Y☆

Dmitri G. Medvedev*, Leonard F. Mausner, Philip Pile

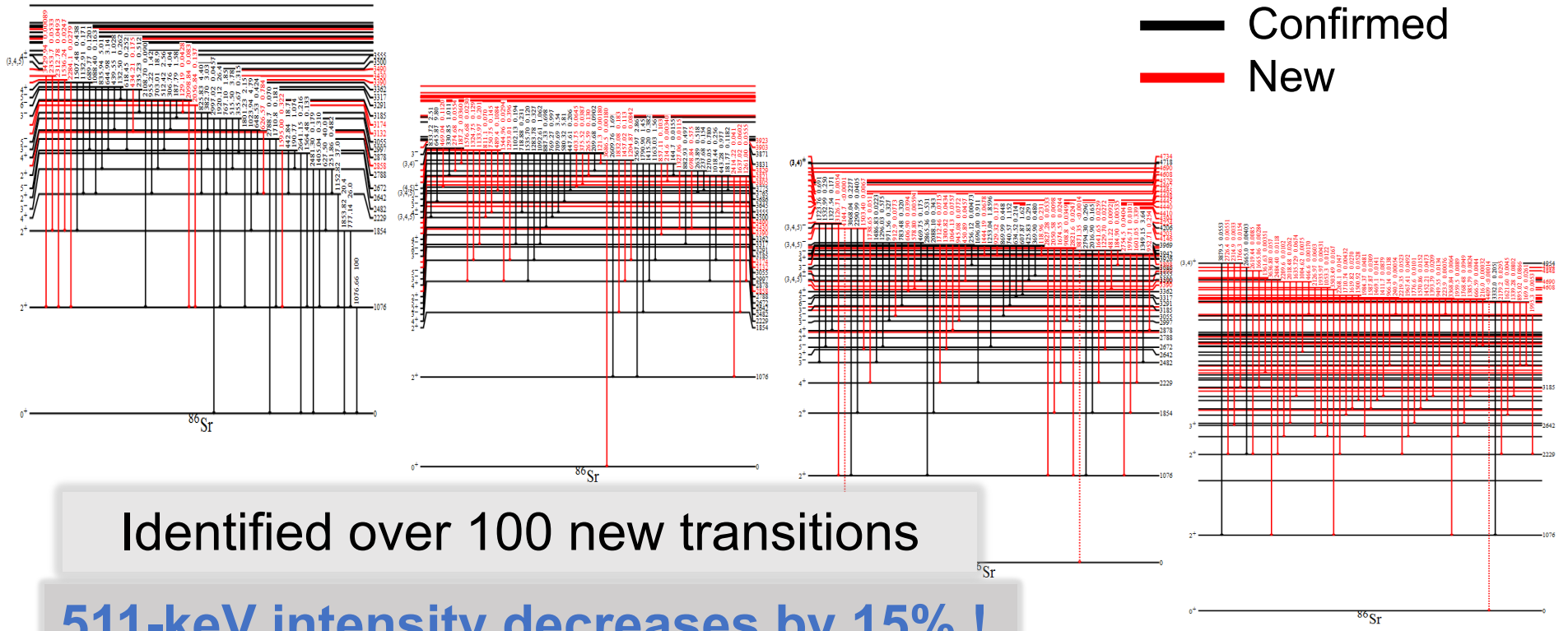
Results on ^{86}Y

Gate on $2^+ \rightarrow 0^+$





Revised Decay Scheme for ^{86}Y



Identified over 100 new transitions

511-keV intensity decreases by 15% !

PHYSICAL REVIEW C **102**, 034316 (2020)

State-of-the-art γ-ray assay of ^{86}Y for medical imaging

A. C. Gula,[1,2] E. A. McCutchan,[2] C. J. Lister,[3] J. P. Greene,[4] S. Zhu,[2,4] P. A. Ellison,[5] R. J. Nickles,[5] M. P. Carpenter,[4] Suzanne V. Smith,[6] and A. A. Sonzogni[2]

August Gula –

- Two term SULI student at NNDC
- Now pursuing PhD at Notre Dame in Nuclear Physics

^{72}Se/^{72}As generator

^{72}As matched with ^{77}As make attractive theranostic partners

U.S. DEPARTMENT OF ENERGY | Office of Science

Nuclear Physics (NP)

May 2014

Growing the Tool Box for Medical Imaging: The Selenium-72/Arsenic-72 Generator

Researchers from Los Alamos National Laboratory and the University of Missouri have designed a new source of a valuable imaging isotope.

Image courtesy of Los Alamos National Laboratory

DE GRUYTER

Radiochim. Acta 2019; 107(4): 279–287

Anthony J. DeGraffenreid, Dmitri G. Medvedev, Timothy E. Phelps, Matthew D. Gott, Suzanne V. Smith, Silvia S. Jurisson and Cathy S. Cutler*

Cross-section measurements and production of ^{72}Se with medium to high energy protons using arsenic containing tar

Applied Radiation and Isotopes 143 (2019) 113–122

Contents lists available at ScienceDirect

Applied Radiation and Isotopes

journal homepage: www.elsevier.com/locate/apradiso

Evaluation of ^{72}Se/^{72}As generator and production of ^{72}Se for supplying ^{72}As as a potential PET imaging radionuclide

Yutian Feng[a], Michael D. Phipps[a], Tim E. Phelps[a], Nkemakonam C. Okoye[a], Jakob E. Baumeister[a], Donald E. Wycoff[a], Eric F. Dorman[b], A. Lake Wooten[b], Vladislav Vlasenko[b], Ashley F. Berendzen[d], D. Scott Wilbur[b], Timothy J. Hoffman[d], Cathy S. Cutler[e], Alan R. Ketring[c], Silvia S. Jurisson[a,c,*]

Current literature on ^{72}As

Decay scheme from 1968

1.E.1

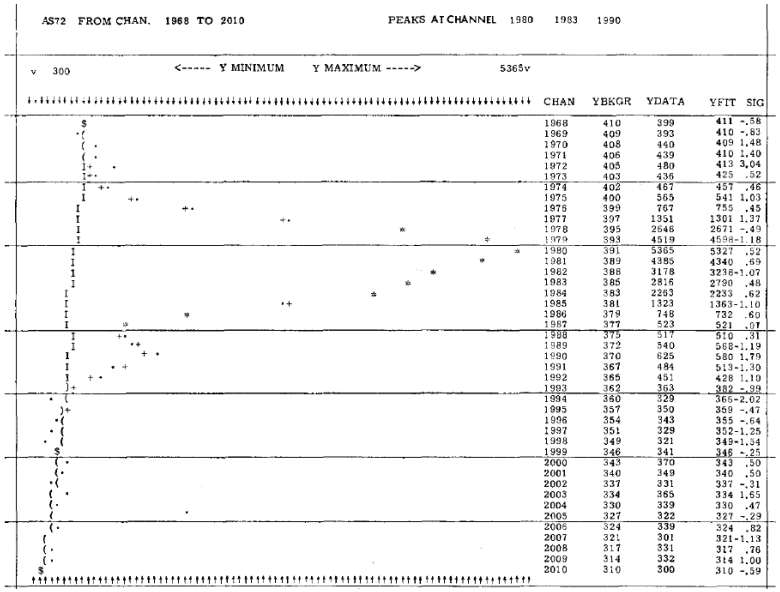
Nuclear Physics A121 (1968) 561—591; © *North-Holland Publishing Co., Amsterdam*

ENERGY LEVELS IN ^{72}Ge FROM THE DECAYS OF ^{72}Ga AND ^{72}As

DAVID C. CAMP

Lawrence Radiation Laboratory, University of California, Livermore, California †

Received 24 June 1968



Absolute intensity from 1968 beta-spectrum measurement

1968VI05 Izv.Akad.Nauk SSSR, Ser.Fiz. 32, 1625 (1968); Bull.Acad.Sci.USSR, Phys.Ser. 32, 1511 (1969)

ON THE POSITRON AND CONVERSION-ELECTRON SPECTRA OF ^{72}As

- V.D.Vitman, B.S.Dzhelepov & A.I.Medvedev

A double-focussing background-free $\pi\sqrt{2}$ β spectrometer has been used to measure the hard components of the β^+ spectrum and the strongest conversion lines of ^{72}As. The resolution was 0.22% with a source efficiency of ~ 0.1%. The sources consisted of arsenic and selenium fractions isolated from yttrium targets after exposure to 660 MeV protons in the synchrocyclotron at the Joint Institute for Nuclear Research. The arsenic fraction contained ^{76}As and ^{74}As in addition

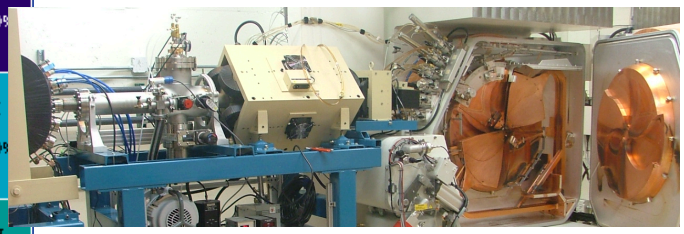
Source production

Protons on natural Ge target
Dominated by (p,n) and (p2n) reactions

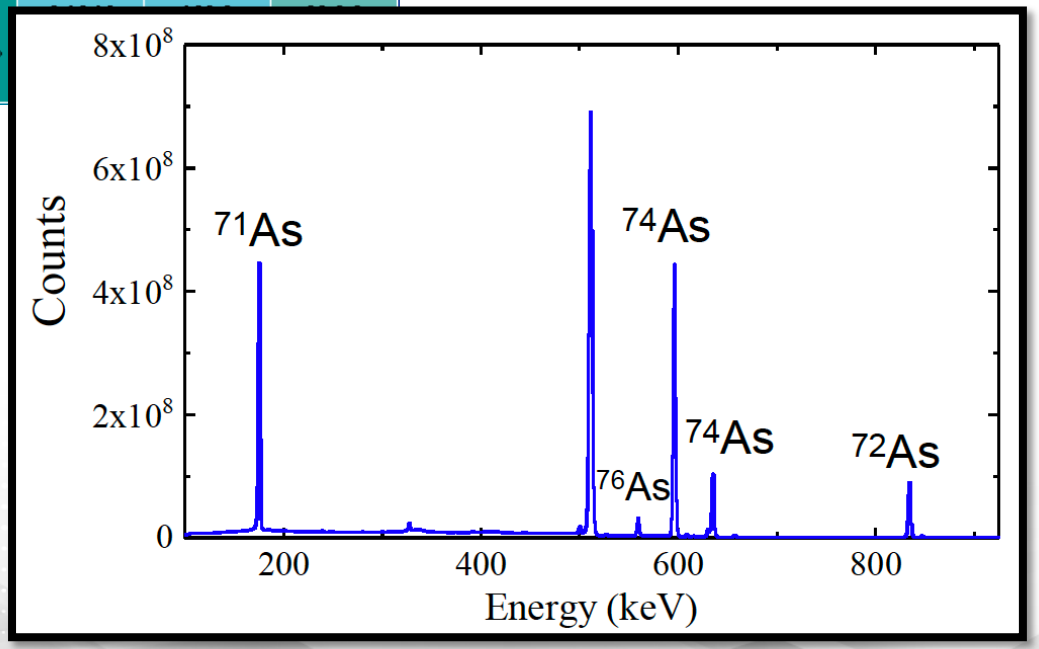
UW-MADISON CYCLOTRON LAB
Just another WiscWeb Wordpress Production Sites site

P. Ellison and J. Nickles

Z									
	71Se 4.74 M ε: 100.00%	72Se 8.40 D ε: 100.00%	73Se 7.15 H ε: 100.00%	74Se STABLE 0.89%	75Se 119.78 D ε: 100.00%	76Se STABLE 9.37%	77Se STABLE 7.63%	78Se STABLE 23.77%	79Se 3.26E+5 Y β-: 100.00%
33	70As 52.6 M ε: 100.00%	71As 65.30 H ε: 100.00%	72As 26.0 H ε: 100.00%	73As 80.30 D ε: 100.00%	74As 17.77 D ε: 66.00% β-: 34.00%	75As STABLE 100%	76As 1.0942 D β-: 100.00%	77As 38.83 H β-: 100.00%	78As 90.7 M β-: 100.00%
32	69Ge 39.05 H ε: 100.00%	70Ge STABLE 20.57%	71Ge 11.43 D ε: 100.00%	72Ge STABLE 27.45%	73Ge STABLE 7.75%	74Ge STABLE 36.50%	75Ge 82.78 M β-: 100.00%	76Ge STABLE 7.73%	77Ge 11.30 H β-: 100.00%
31	68Ga 67.71 M ε: 100.00%	69Ga STABLE 60.108%	70Ga 21.14 M β-: 99.59% ε: 0.41%	71Ga STABLE 39.892%	72Ga 14.10 H β-: 100.00%	73Ga 4.86 H β-: 100.00%	74Ga	75Ga	76Ga



Many experiments in one !



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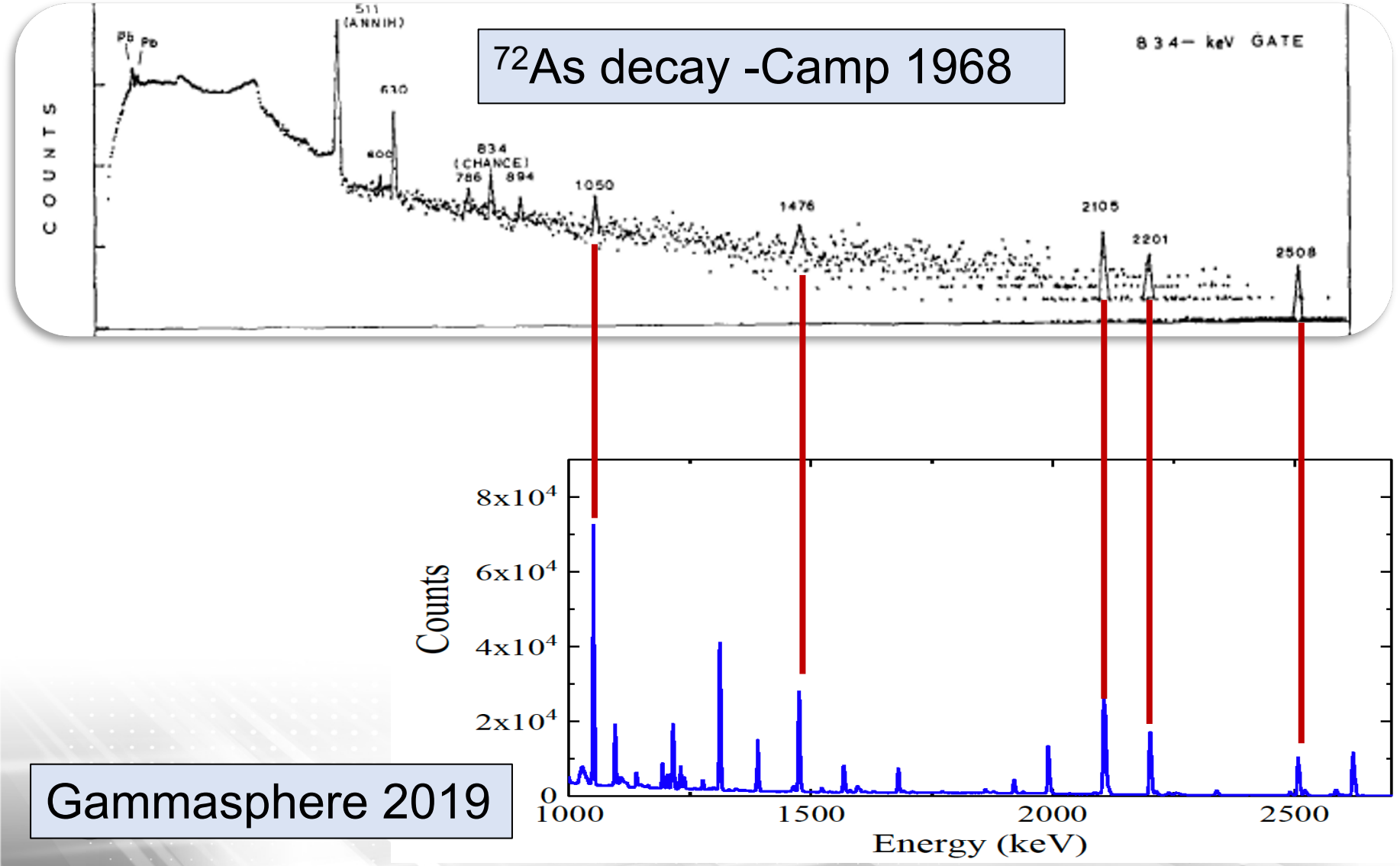
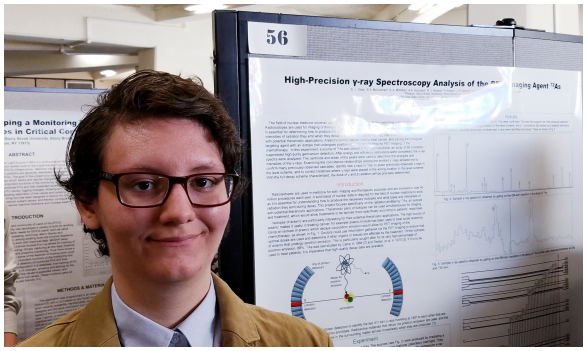
Improvements after 50+ years



Gammasphere 2019

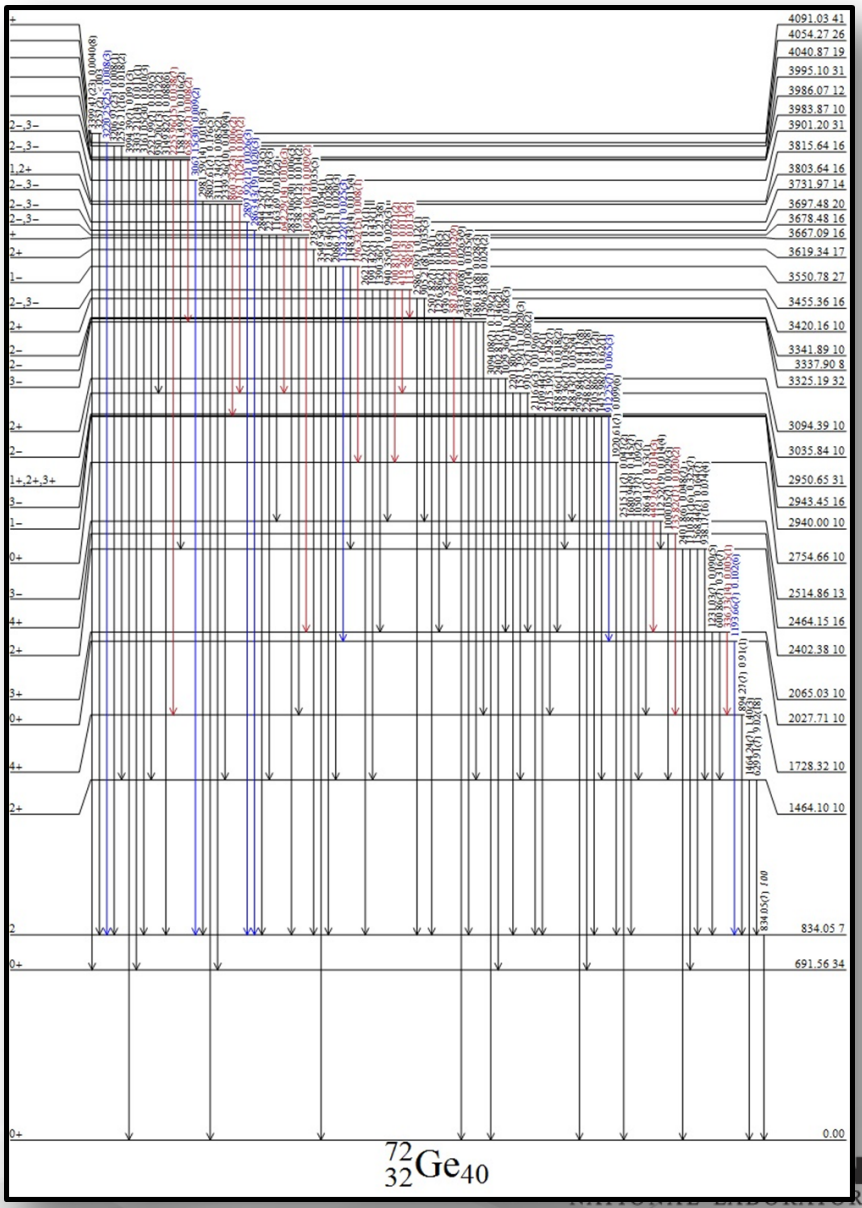
Level scheme analysis complete



E.J. Gass – SULI student, Stony Brook Honors Thesis

Now Graduate student at UMASS Lowell – funded through this FOA

- Few revisions
- Overall confirmation of level scheme by Camp



Future Work

- Measurements on ^{134}Ce/^{134}La and ^{119}Te
- Likely transition from Gammasphere to LARA at Lowell – 6 element Compton-suppressed HPGe array
- Training can continue, without need for travel